

TECHNICAL MEMO 2020-008

Essex Pastures Rooftop Equipment Noise Prediction Revision 0

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1.0 INTRODUCTION

Noise Control Engineering, LLC (NCE) has been retained by 36 Essex Road LP to develop a noise prediction model for heat pump units that are being installed on the roof of four proposed 33-Unit 3-story buildings at 42-44 Essex Road in Ipswich, MA. Each building has a total of 34 Mitsubishi Electric H2I MZX Multi-Zone heating and cooling systems. The purpose of the noise study was to make sure that the equipment will not generate any excessive noise levels that would disturb the abutters off of Heartbreak Road. This report presents the results of a prediction noise levels on the North and East property lines of the proposed buildings.

2.0 NOISE MODEL

The noise prediction was performed using environmental noise modeling software CadnaA to predict the sound pressure levels at the site property lines. CadnaA uses the international standard ISO 9613 to calculate sound propagation using spherical spreading, reflection off hard surfaces, and acoustic shielding of large equipment and buildings [1]. The general layout of the site was taken from the Site Plan as provided by 36 Essex Road LP (Figure 1). Figure 2 shows a rendering of the proposed heating and cooling system layout. The units are located on the roof approximately 39 feet off of grade and are surrounded by a 4 foot side wall. Noise specifications for the units show that they have a rating of 49 dBA at 1 meter for cooling and 53 dBA at 1 meter for heating. Spectral data for use in the analysis were acquired online from the manufacturer's website.

The site plan was scaled to the correct physical dimensions and georeferenced to ESRI satellite imagery using QGIS Geographic Information System software [2] and was then imported into the CadnaA software. For each building, the 34 noise sources were modeled as distributed area sources and the 4 foot wall was modeled as a barrier. To be conservative, it was assumed that the effective noise sources were located at the top of the barrier. Six receptor locations were located at the property lines on the North and East of the site and an additional receptor was placed at the property line near 35 Heartbreak Road. The receptors were modeled at a 5 foot height. The model geometry is shown in Figure 3.

Sound Pressure levels for both the heating and cooling cycles of the units were obtained from the Mitsubishi Electric Technical Service Manual [3]. These were converted to sound power levels, shown in Table 1, for input into the prediction model. Note that the levels in the 31.5 Hz octave band were not explicitly given in the manual so they were estimated based upon measured data from similar units. For the most conservative prediction, it was assumed that all units would be operating at the same time. To do this, total octave band sound power levels for 34 units running simultaneously were calculated and then applied to each of the four distributed area sources at the locations shown in Figure 3.



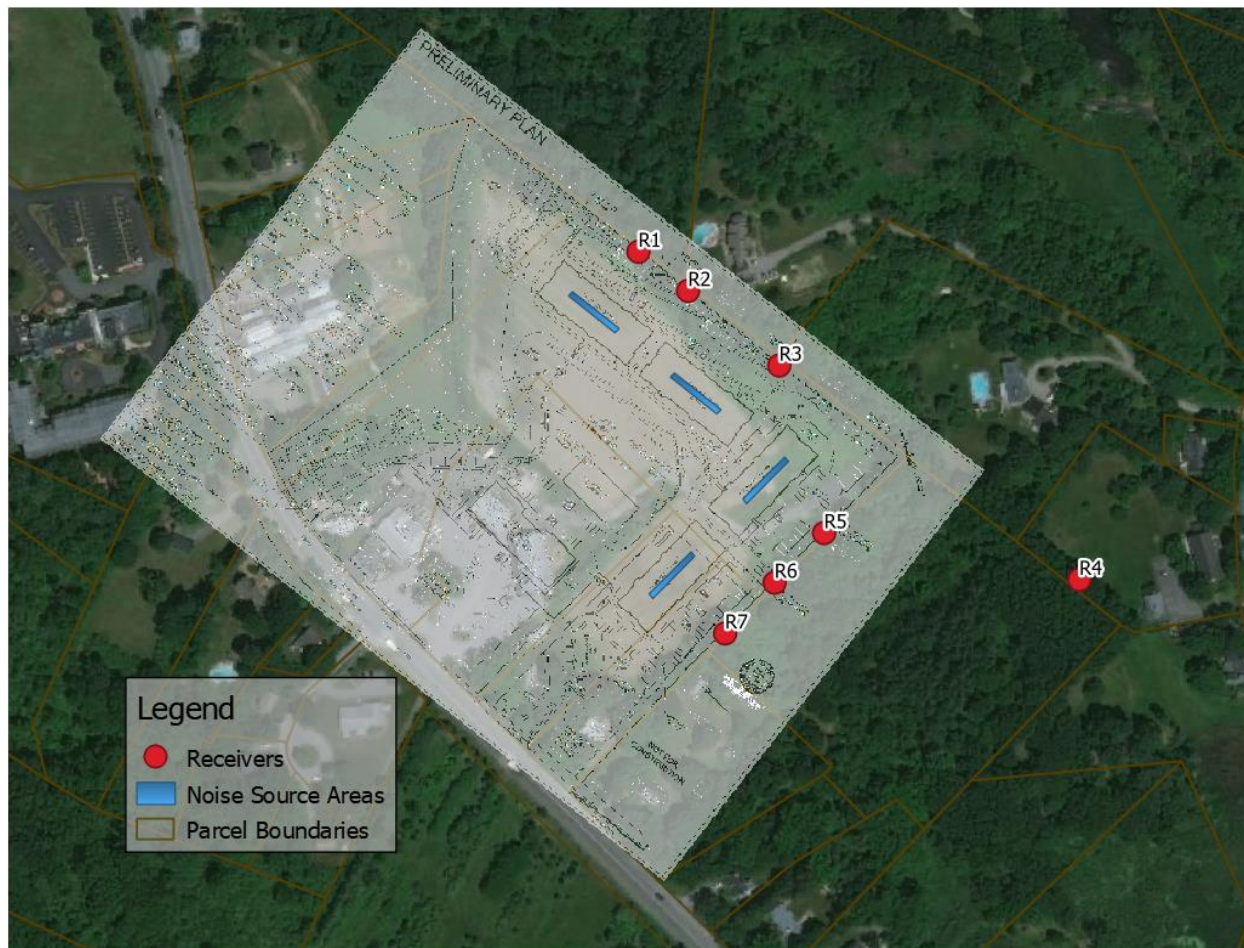


Figure 3: Location of receptors and sources in noise model

	Octave Band Center Frequency (Hz)									Broadband, A-Weighted
	31.5	63	125	250	500	1000	2000	4000	8000	
Cooling	69	68	61	59	59	55	50	44	42	60
Heating	67	66	67	67	63	58	52	48	42	64

Table 1: Sound power levels for heat pump air conditioning units, dB re 10^{-12} W

3.0 RESULTS AND DISCUSSION

The predicted broadband and octave band noise levels at all receptor locations for both the heating and cooling cycles of the units are shown in Table 2. At all receptor locations, all predicted overall noise levels due to the operation of all 34 units were 30 dB(A) or lower. Regarding noise, the Town of Ipswich Protective Zoning Bylaw [4] states, in general, that activities should not generate noise that is a nuisance or is offensive. Based on the maximum predicted levels of 30 dB(A), it is unlikely that the operation of the units would pose a nuisance or be offensive to abutting neighbors because background levels in residential areas are typically

around this level or often higher. Furthermore, noise levels due to these units would be even lower at residence locations because of additional distance from the property lines.

		SPL, dB(A)	
Receiver	Location	Cooling	Heating
R1	North Property Line	22	27
R2	North Property Line	25	30
R3	North Property Line	26	30
R4	Close to 35 Heartbreak Road Property Line	19	23
R5	East Property Line	24	29
R6	East Property Line	25	30
R7	East Property Line	25	29

Table 2: Predicted levels at property line receptor locations, dB(A)

4.0 REFERENCES

1. "ISO 9613-2:1996 - Acoustics -- Attenuation of Sound during Propagation Outdoors -- Part 2: General Method of Calculation." ISO - International Organization for Standardization
2. QGIS Geographic Information System (<https://www.qgis.org/en/site/>)
3. Mitsubishi Electric Technical & Service manual for Split-Type Heat Pump Air Conditioners, No. OCH573 Edition-F, February 2019.
4. Town of Ipswich Massachusetts Protective Zoning Bylaw, dated May 7, 1977 (as amended through October 2018)